

WHAT IS CLAIMED IS:

1. A code quantity control apparatus employed in equipment comprising:

a decoding unit for inputting picture compressed information in accordance with a predetermined format and decoding said picture compressed information till a pixel domain or a frequency domain, wherein said picture compressed information includes at least an intraframe encoded picture, an interframe forward directional prediction encoded picture and a bi-directional prediction encoded picture and has completed an external encoding process based on discrete cosine transformation and motion compensation; and

an encoding unit for encoding picture compressed information decoded by said decoding unit wherein code quantity control is executed in an internal encoding process for each macroblock on the basis of a virtual buffer by using information extracted from said picture compressed information input to said decoding unit.

2. A code quantity control apparatus according to claim 1 wherein an initial occupation size of said virtual buffer for a first intraframe encoded picture is computed on the basis of information extracted from said picture compressed information input to said decoding

unit.

3. A code quantity control apparatus according to claim 2 wherein an initial occupation size of said virtual buffer for a first intraframe encoded picture is computed by execution of the steps of:

 multiplying an average quantization scale for said first intraframe encoded picture by a code quantity for said first intraframe encoded picture to result in a first product;

 dividing said first product by a target code quantity for said first intraframe encoded picture to result in a reference quantization scale for said first intraframe encoded picture;

 multiplying said reference quantization scale for said first intraframe encoded picture by a parameter for controlling a response speed of a feedback loop determined by said predetermined format to result in a second product; and

 dividing said second product by a predetermined constant.

4. A code quantity control apparatus according to claim 3 wherein:

 an initial occupation size of said virtual buffer for a first interframe forward directional prediction

encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first intraframe encoded picture and a quantization scale of said first interframe forward directional prediction encoded picture taking a quantization scale of said first intraframe encoded picture as a reference; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first intraframe encoded picture and a quantization scale of said first bi-directional prediction encoded picture taking a quantization scale of said first intraframe encoded picture as a reference.

5. A code quantity control apparatus according to claim 3 wherein:

a reference quantization scale for a first interframe forward directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of an average quantization scale for said first interframe forward directional prediction encoded picture and a quantity of code allocated to said first interframe forward directional prediction encoded picture by a target code

quantity for said first interframe forward directional prediction encoded picture; and

a reference quantization scale for a first bi-directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of an average quantization scale for said first bi-directional prediction encoded picture and a quantity of code allocated to said first bi-directional prediction encoded picture by a target code quantity for said first bi-directional prediction encoded picture.

6. A code quantity control apparatus according to claim 3 wherein:

an initial occupation size of said virtual buffer for a first interframe forward directional prediction encoded picture is a quotient obtained by dividing a product of a reference quantization scale for said first interframe forward directional prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture is a quotient obtained by dividing a product of a reference quantization scale for said first bi-directional

prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant.

7. A code quantity control apparatus according to claim 1 wherein an operation to update occupation sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures is executed based on information extracted from said input picture compressed information.

8. A code quantity control apparatus according to claim 7 wherein said occupation sizes d_j^i , d_j^p and d_j^b of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures in said input picture compressed information respectively are updated in accordance with the following equations:

$$d_j^i = d_0^i + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{i,k}}{X_{i,total}} \times T_i$$

$$d_j^p = d_0^p + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{p,k}}{X_{p,total}} \times T_p$$

$$d_j^b = d_0^b + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{b,k}}{X_{b,total}} \times T_b$$

where:

notations d_0^i , d_0^p and d_0^b denote initial occupation sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,k}$, $X_{p,k}$ and $X_{b,k}$ denote activities for macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$\begin{aligned} X_{i,k} &= Q_{i,k} \cdot B_{i,k} \\ X_{p,k} &= Q_{p,k} \cdot B_{p,k} \\ X_{b,k} &= Q_{b,k} \cdot B_{b,k} \end{aligned}$$

notations $Q_{i,k}$, $Q_{p,k}$ and $Q_{b,k}$ denote quantization scales for said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $B_{i,k}$, $B_{p,k}$ and $B_{b,k}$ denote quantities of code allocated to said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,total}$, $X_{p,total}$ and $X_{b,total}$ denote total activities for all macroblocks included in one frame of said input picture compressed information for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$\begin{aligned} X_{i,total} &= \sum_{k=0}^{MB_cnt} X_{i,k} \\ X_{p,total} &= \sum_{k=0}^{MB_cnt} X_{p,k} \\ X_{b,total} &= \sum_{k=0}^{MB_cnt} X_{b,k} \end{aligned}$$

notation MB_cnt denotes the number of macroblocks included in one frame;

notations T_i , T_p and T_b denote target code quantities per frame for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively; and

notation B_j denotes a quantity of code generated in the j th macroblock in a frame seen with a first macroblock in said frame regarded as a 0th macroblock.

9. A code quantity control method employed in method comprising the steps of:

inputting picture compressed information in accordance with a predetermined format and decoding said picture compressed information till a pixel domain or a frequency domain, wherein said picture compressed information includes at least an intraframe encoded picture, an interframe forward directional prediction encoded picture and a bi-directional prediction encoded picture and has completed an encoding process based on discrete cosine transformation and motion compensation; and

encoding said decoded picture compressed information by execution of code quantity control for each macroblock on the basis of a virtual buffer by using information extracted from said input picture compressed information.

10. A code quantity control method according to claim 9 whereby an initial occupation size of said virtual buffer for a first intraframe encoded picture is computed on the basis of information extracted from said input picture compressed information.

11. A code quantity control method according to claim 10 whereby an initial occupation size of said virtual buffer for a first intraframe encoded picture is computed by execution of the steps of:

multiplying an average quantization scale for said first intraframe encoded picture by a code quantity for said first intraframe encoded picture to result in a first product;

dividing said first product by a target code quantity for said first intraframe encoded picture to result in a reference quantization scale for said first intraframe encoded picture;

multiplying said reference quantization scale for said first intraframe encoded picture by a parameter for controlling a response speed of a feedback loop determined by said predetermined format to result in a second product; and

dividing said second product by a predetermined constant.

12. A code quantity control method according to claim 11 whereby:

an initial occupation size of said virtual buffer for a first interframe forward directional prediction encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first intraframe encoded picture and a quantization scale of said first interframe forward directional prediction encoded picture taking a quantization scale of said first

intraframe encoded picture as a reference; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first intraframe encoded picture and a quantization scale of said first bi-directional prediction encoded picture taking a quantization scale of said first intraframe encoded picture as a reference.

13. A code quantity control method according to claim 11 whereby:

a reference quantization scale for a first interframe forward directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of an average quantization scale for said first interframe forward directional prediction encoded picture and a quantity of code allocated to said first interframe forward directional prediction encoded picture by a target code quantity for said first interframe forward directional prediction encoded picture; and

a reference quantization scale for a first bi-directional prediction encoded picture of said input picture compressed information is a quotient obtained by

dividing a product of an average quantization scale for said first bi-directional prediction encoded picture and a quantity of code allocated to said first bi-directional prediction encoded picture by a target code quantity for said first bi-directional prediction encoded picture.

14. A code quantity control method according to claim 11 whereby:

an initial occupation size of said virtual buffer for a first interframe forward directional prediction encoded picture is a quotient obtained by dividing a product of a reference quantization scale for said first interframe forward directional prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture is a quotient obtained by dividing a product of a reference quantization scale for said first bi-directional prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant.

15. A code quantity control method according to

claim 9 whereby an operation to update occupation sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures is executed based on information extracted from said input picture compressed information.

16. A code quantity control method according to claim 15 whereby said occupation sizes d_j^i , d_j^p and d_j^b of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures in said input picture compressed information respectively are updated in accordance with the following equations:

$$d_j^i = d_0^i + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{i,k}}{X_{i,total}} \times T_i$$

$$d_j^p = d_0^p + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{p,k}}{X_{p,total}} \times T_p$$

$$d_j^b = d_0^b + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{b,k}}{X_{b,total}} \times T_b$$

where:

notations d_0^i , d_0^p and d_0^b denote initial occupation

sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,k}$, $X_{p,k}$ and $X_{b,k}$ denote activities for macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$\begin{aligned} X_{i,k} &= Q_{i,k} \cdot B_{i,k} \\ X_{p,k} &= Q_{p,k} \cdot B_{p,k} \\ X_{b,k} &= Q_{b,k} \cdot B_{b,k} \end{aligned}$$

notations $Q_{i,k}$, $Q_{p,k}$ and $Q_{b,k}$ denote quantization scales for said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $B_{i,k}$, $B_{p,k}$ and $B_{b,k}$ denote quantities of code allocated to said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,total}$, $X_{p,total}$ and $X_{b,total}$ denote total

activities for all macroblocks included in one frame of said input picture compressed information for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$X_{i,total} = \sum_{k=0}^{MB_cnt} X_{i,k}$$

$$X_{p,total} = \sum_{k=0}^{MB_cnt} X_{p,k}$$

$$X_{b,total} = \sum_{k=0}^{MB_cnt} X_{b,k}$$

notation MB_cnt denotes the number of macroblocks included in one frame;

notations T_i , T_p and T_b denote target code quantities per frame for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively; and

notation B_j denotes a quantity of code generated in the j th macroblock in a frame seen with a first macroblock in said frame regarded as a 0th macroblock.

17. A picture information transformation method comprising:

a step of inputting picture compressed information

in accordance with a predetermined format and decoding said picture compressed information till a pixel domain or a frequency domain, wherein said picture compressed information includes at least an intraframe encoded picture, an interframe forward directional prediction encoded picture and a bi-directional prediction encoded picture and has completed an encoding process based on discrete cosine transformation and motion compensation;

a step of encoding said decoded picture compressed information by execution of picture information transformation for each macroblock; and

a code quantity control process of controlling a code quantity of each macroblock on the basis of said virtual buffer by using information extracted from said input picture compressed information.

18. A picture information transformation method according to claim 17 whereby, in said code quantity control process, an initial occupation size of said virtual buffer for a first intraframe encoded picture is computed on the basis of information extracted from said input picture compressed information.

19. A picture information transformation method according to claim 18 whereby, in said code quantity control process, an initial occupation size of said

virtual buffer for a first intraframe encoded picture is computed by executing the steps of:

 multiplying an average quantization scale for said first intraframe encoded picture by a code quantity for said first intraframe encoded picture to result in a first product;

 dividing said first product by a target code quantity for said first intraframe encoded picture to result in a reference quantization scale for said first intraframe encoded picture;

 multiplying said reference quantization scale for said first intraframe encoded picture by a parameter for controlling a response speed of a feedback loop determined by said predetermined format to result in a second product; and

 dividing said second product by a predetermined constant.

20. A picture information transformation method according to claim 19 whereby, in said code quantity control process:

 an initial occupation size of said virtual buffer for a first interframe forward directional prediction encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first

intraframe encoded picture and a quantization scale of said first interframe forward directional prediction encoded picture taking a quantization scale of said first intraframe encoded picture as a reference; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture is computed as a product of an initial occupation size of said virtual buffer for a first intraframe encoded picture and a quantization scale of said first bi-directional prediction encoded picture taking a quantization scale of said first intraframe encoded picture as a reference.

21. A picture information transformation method according to claim 19 whereby, in said code quantity control process:

a reference quantization scale for a first interframe forward directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of an average quantization scale for said first interframe forward directional prediction encoded picture and a quantity of code allocated to said first interframe forward directional prediction encoded picture by a target code quantity for said first interframe forward directional

prediction encoded picture; and

a reference quantization scale for a first bi-directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of an average quantization scale for said first bi-directional prediction encoded picture and a quantity of code allocated to said first bi-directional prediction encoded picture by a target code quantity for said first bi-directional prediction encoded picture.

22. A picture information transformation method according to claim 19 whereby, in said code quantity control process:

an initial occupation size of said virtual buffer for a first interframe forward directional prediction encoded picture of said input picture compressed information is a quotient obtained by dividing a product of a reference quantization scale for said first interframe forward directional prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant; and

an initial occupation size of said virtual buffer for a first bi-directional prediction encoded picture of said input picture compressed information is a quotient

obtained by dividing a product of a reference quantization scale for said first bi-directional prediction encoded picture and a parameter for controlling a response speed of a feedback loop determined by said predetermined format by said predetermined constant.

23. A picture information transformation method according to claim 17 whereby, in said code quantity control process, an operation to update occupation sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures is based on information extracted from said input picture compressed information.

24. A picture information transformation method according to claim 23 whereby, in said code quantity control process, said occupation sizes d_j^i , d_j^p and d_j^b of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures in said input picture compressed information respectively are updated in accordance with the following equations:

$$d_j^i = d_0^i + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{i,k}}{X_{i,total}} \times T_i$$

$$d_j^p = d_0^p + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{p,k}}{X_{p,total}} \times T_p$$

$$d_j^b = d_0^b + B_{j-1} - \frac{\sum_{k=0}^{j-1} X_{b,k}}{X_{b,total}} \times T_b$$

where:

notations d_0^i , d_0^p and d_0^b denote initial occupation sizes of said virtual buffer for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,k}$, $X_{p,k}$ and $X_{b,k}$ denote activities for macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$X_{i,k} = Q_{i,k} \cdot B_{i,k}$$

$$X_{p,k} = Q_{p,k} \cdot B_{p,k}$$

$$X_{b,k} = Q_{b,k} \cdot B_{b,k}$$

notations $Q_{i,k}$, $Q_{p,k}$ and $Q_{b,k}$ denote quantization scales for said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $B_{i,k}$, $B_{p,k}$ and $B_{b,k}$ denote quantities of code allocated to said macroblocks included in said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively;

notations $X_{i,total}$, $X_{p,total}$ and $X_{b,total}$ denote total activities for all macroblocks included in one frame of said input picture compressed information for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively and are defined by the following equations:

$$\begin{aligned} X_{i,total} &= \sum_{k=0}^{MB_cnt} X_{i,k} \\ X_{p,total} &= \sum_{k=0}^{MB_cnt} X_{p,k} \\ X_{b,total} &= \sum_{k=0}^{MB_cnt} X_{b,k} \end{aligned}$$

notation MB_cnt denotes the number of macroblocks included in one frame;

notations T_i , T_p and T_b denote target code quantities per frame for said intraframe, interframe forward directional prediction and bi-directional prediction encoded pictures respectively; and

notation B_j denotes a quantity of code generated in the j th macroblock in a frame seen with a first macroblock in said frame regarded as a 0th macroblock.